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Norton

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(54) **TRANSLUCENT OBJECT PRESENCE AND CONDITION DETECTION BASED ON DETECTED LIGHT INTENSITY**

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(51) **Int. Cl.**

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G01J 1/42	(2006.01)
G01M 11/02	(2006.01)
G01N 21/958	(2006.01)

(Continued)

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CPC . ***G01V 8/12*** (2013.01); ***B23K 26/03*** (2013.01); ***B23K 26/702*** (2015.10); ***G01J 1/18*** (2013.01); ***G01J 1/42*** (2013.01); ***G01M 11/0278*** (2013.01); ***G01N 21/958*** (2013.01); ***G03B 21/2086*** (2013.01)

(58) **Field of Classification Search**

CPC G01P 13/0086; G01P 3/68
USPC ..... 250/221, 559.4, 223 R, 223 B; 356/239.1, 239.2

See application file for complete search history.

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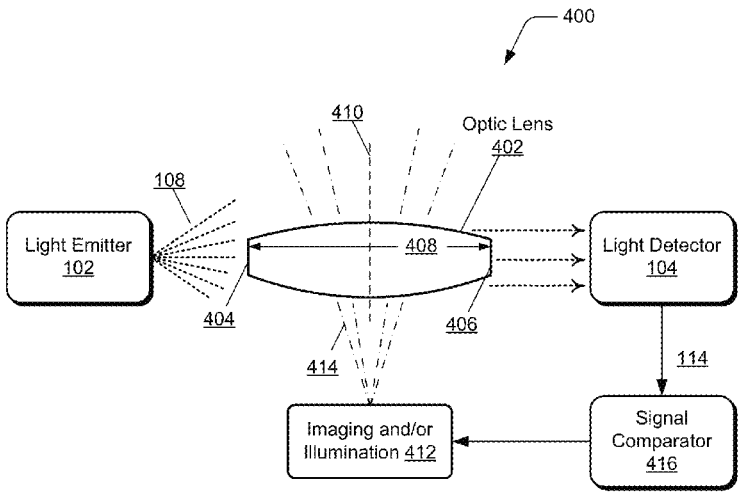
(57) **ABSTRACT**

In embodiments of object presence and condition detection, a light is emitted that is directed at a first edge of a translucent object to pass through the translucent object, such as a lens. An intensity of the light is detected proximate an opposing, second edge of the translucent object. A presence and/or a condition of the translucent object can then be determined based on the detected intensity of the light that passes through the object. The translucent object can be implemented as a multi-lens array, and a laser light is directed through optic surfaces of the multi-lens array with a laser. The presence and the condition of the multi-lens array can be continuously determined as a safety compliance of the laser light being directed through the multi-lens array.

20 Claims, 6 Drawing Sheets



(51) **Int. Cl.**
G03B 21/20 (2006.01)
B23K 26/03 (2006.01)

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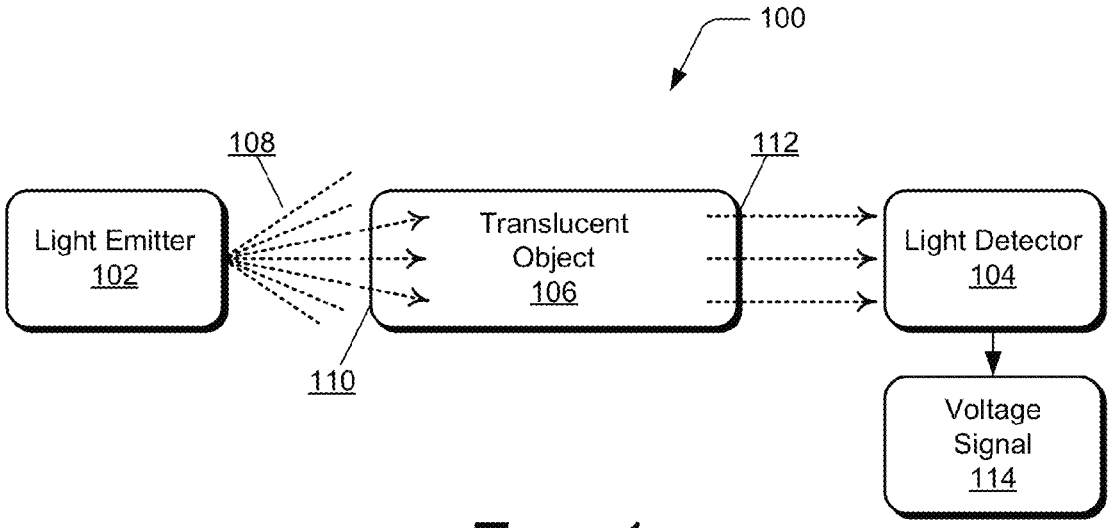
100
108
112
Light Emitter
102
Translucent
Object
106
Light Detector
104
110
Voltage
Signal
114

FIG. 1

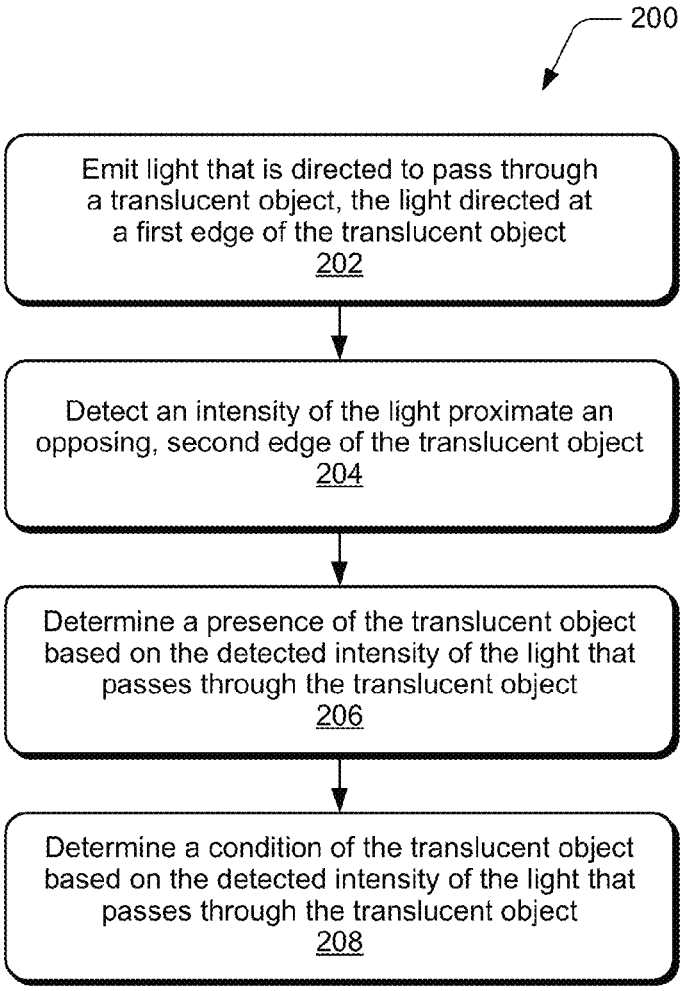
200
Emit light that is directed to pass through a translucent object, the light directed at a first edge of the translucent object
202
Detect an intensity of the light proximate an opposing, second edge of the translucent object
204
Determine a presence of the translucent object based on the detected intensity of the light that passes through the translucent object
206
Determine a condition of the translucent object based on the detected intensity of the light that passes through the translucent object
208

FIG. 2

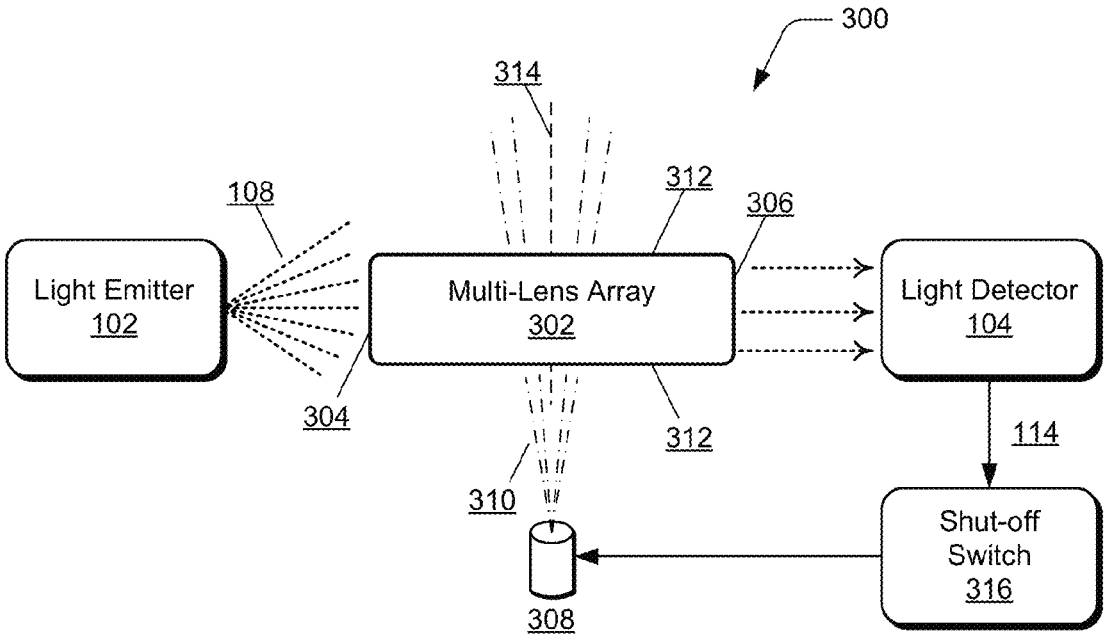
300
314
108
312
306
Light Emitter
102
Multi-Lens Array
302
Light Detector
104
304
312
114
310
Shut-off
Switch
316
308

FIG. 3

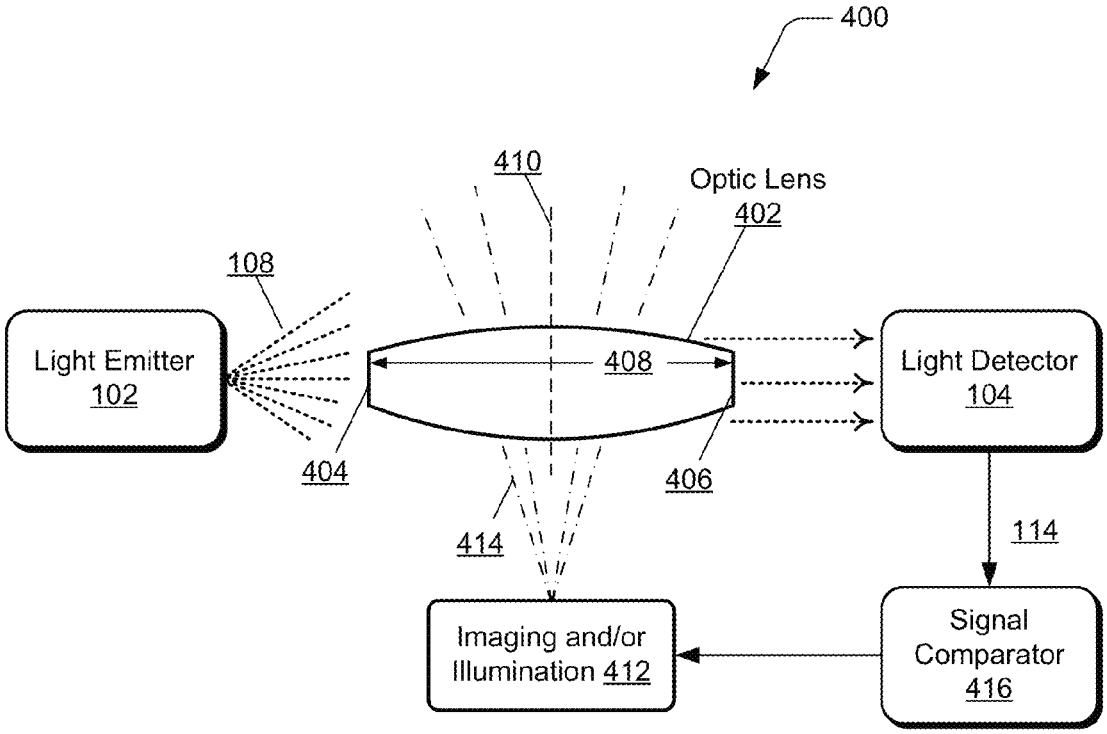
400
410
Optic Lens
402
108
Light Emitter
102
408
Light Detector
104
404
406
114
414
Imaging and/or
Illumination 412
Signal
Comparator
416

FIG. 4

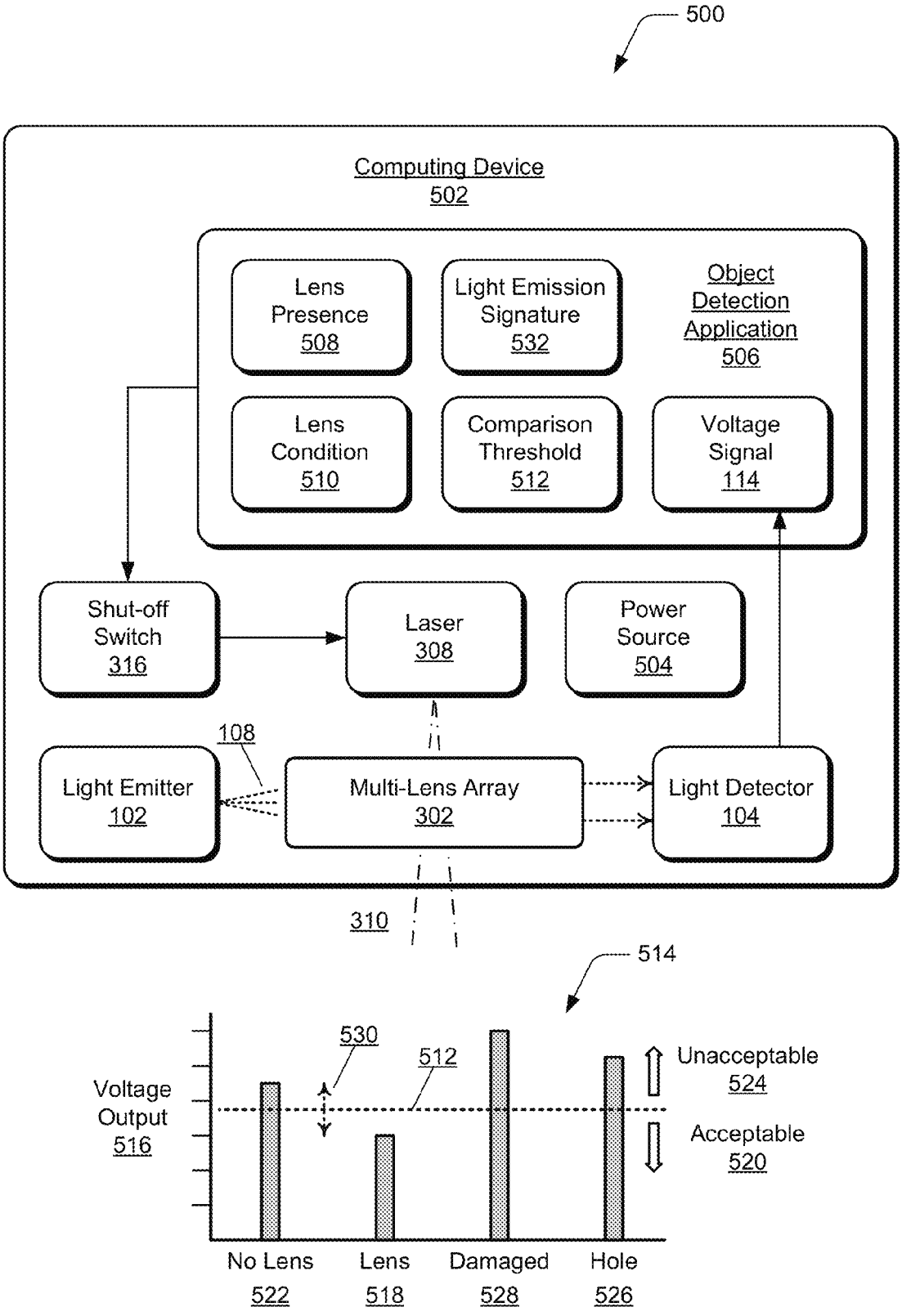
500
Computing Device
502
Lens Presence
508
Light Emission Signature
532
Object Detection Application
506
Lens Condition
510
Comparison Threshold
512
Voltage Signal
114
Shut-off Switch
316
Laser
308
Power Source
504
108
Light Emitter
102
Multi-Lens Array
302
Light Detector
104
310
514
530
512
Voltage Output
516
Unacceptable
524
Acceptable
520
No Lens
522
Lens
518
Damaged
528
Hole
526

FIG. 5

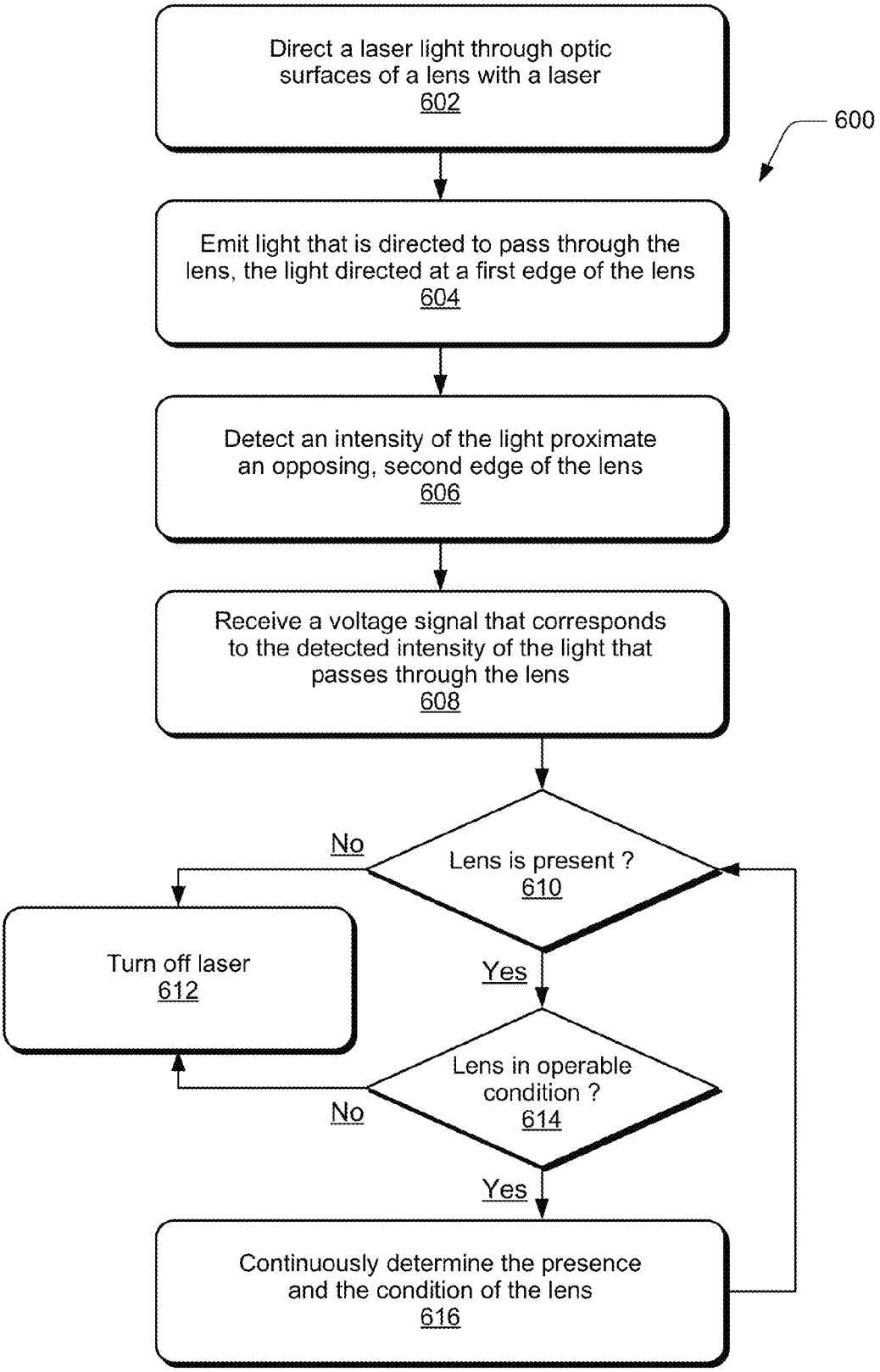
Direct a laser light through optic surfaces of a lens with a laser
602
600
Emit light that is directed to pass through the lens, the light directed at a first edge of the lens
604
Detect an intensity of the light proximate an opposing, second edge of the lens
606
Receive a voltage signal that corresponds to the detected intensity of the light that passes through the lens
608
Lens is present ?
610
No
Yes
Turn off laser
612
Lens in operable condition ?
614
No
Yes
Continuously determine the presence and the condition of the lens
616

FIG. 6

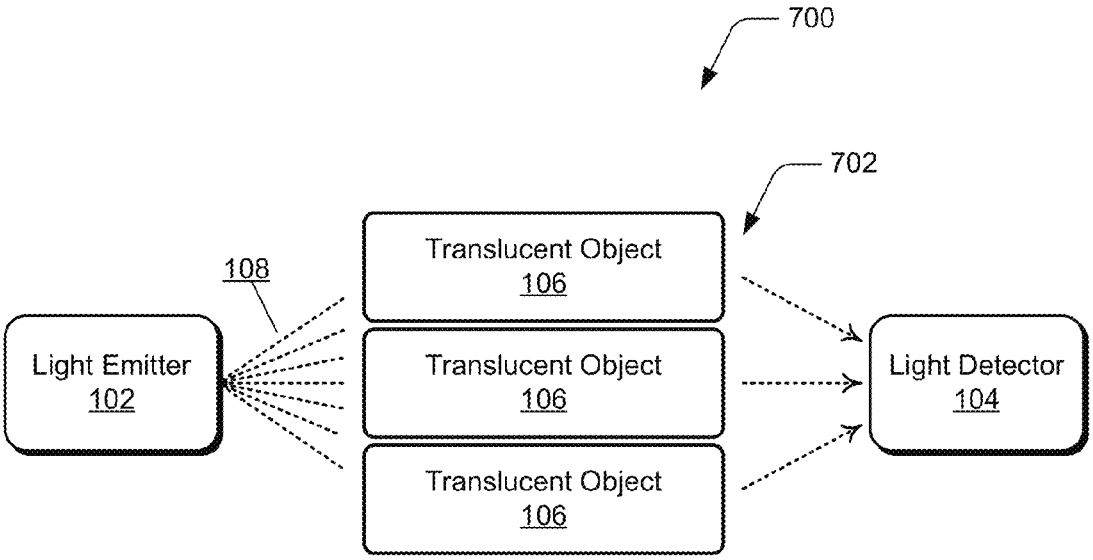
700
702
108
Translucent Object
106
Translucent Object
106
Translucent Object
106
Light Emitter
102
Light Detector
104

FIG. 7

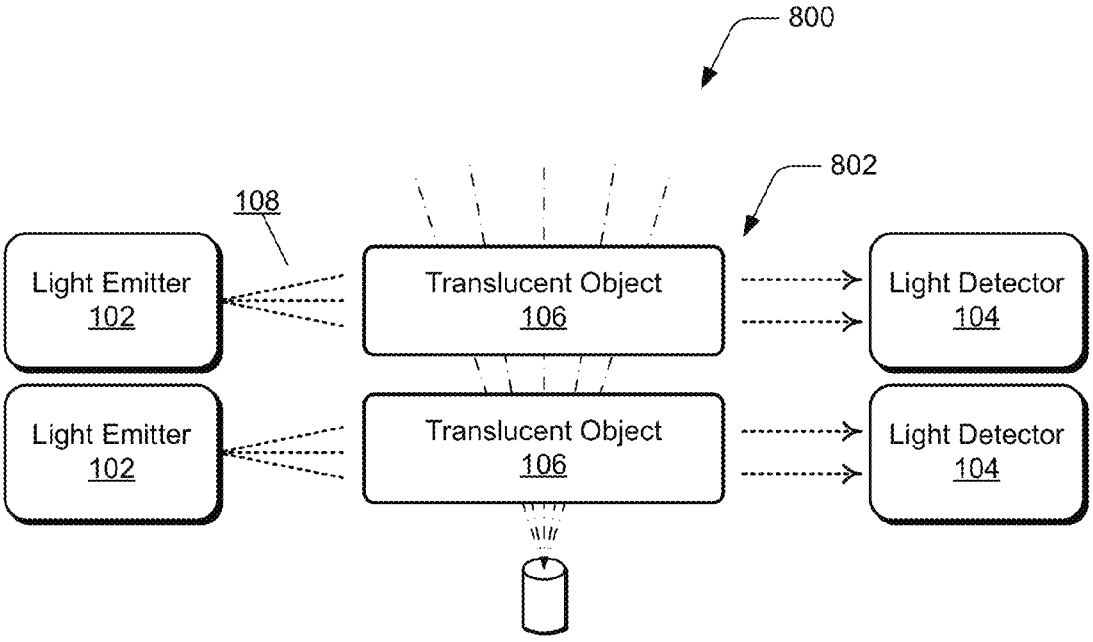
800
802
108
Light Emitter
102
Translucent Object
106
Light Detector
104
Light Emitter
102
Translucent Object
106
Light Detector
104

FIG. 8

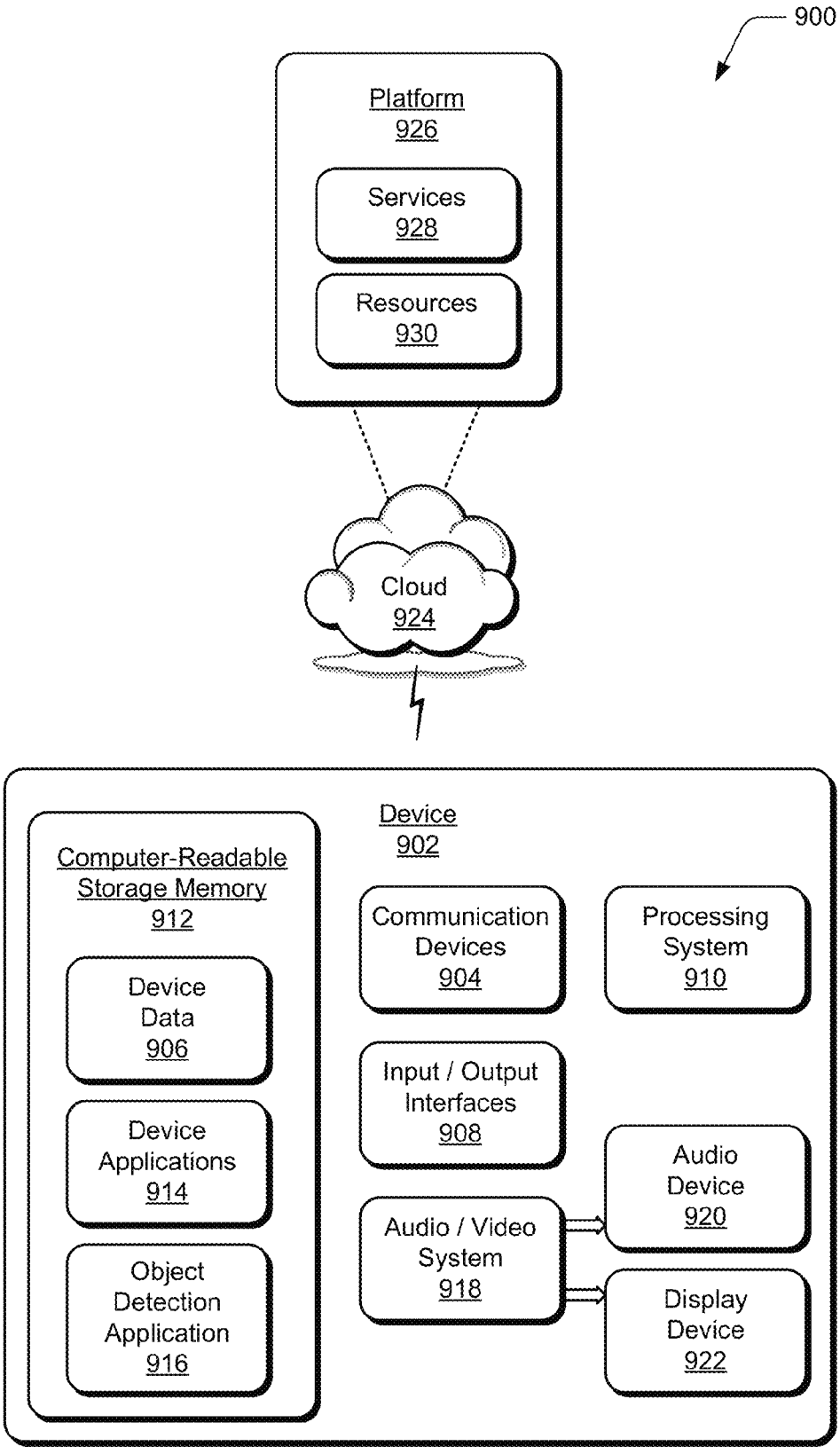
900
Platform
926
Services
928
Resources
930
Cloud
924
Device
902
Computer-Readable
Storage Memory
912
Device
Data
906
Device
Applications
914
Object
Detection
Application
916
Communication
Devices
904
Processing
System
910
Input / Output
Interfaces
908
Audio / Video
System
918
Audio
Device
920
Display
Device
922

FIG. 9

TRANSLUCENT OBJECT PRESENCE AND CONDITION DETECTION BASED ON DETECTED LIGHT INTENSITY

BACKGROUND

Consumer electronics, such as a gaming system or device, may use a high-powered laser and the intensity of the laser light is reduced through the use of various lenses and/or translucent material so that the laser light is safe to shine on a person, such as on a person's face for detection and recognition implementations. If a lens or the translucent material is missing, has a hole or crack in it, or is otherwise damaged, the laser light may not be properly diffused and the intensity of the light can cause an eye injury to a user of the device. In various systems and devices, safety compliance features are implemented to verify the presence and condition of the lenses so as to avoid a laser causing eye damage, which can occur in just a matter of milliseconds. However, conventional techniques do not directly measure the presence or condition of the lenses, but rather detect a proxy component and infer the condition of the lenses. This can potentially result in false inferences, since the proxy does not guarantee that a lens was even installed in the first place, or that it was free of damage when it was installed.

SUMMARY

This Summary introduces features and concepts of object presence and condition detection, which is further described below in the Detailed Description and/or shown in the Figures. This Summary should not be considered to describe essential features of the claimed subject matter, nor used to determine or limit the scope of the claimed subject matter.

Object presence and condition detection is described. In embodiments, a light is emitted that is directed at a first edge of a translucent object to pass through the translucent object, such as a lens. An intensity of the light is detected proximate an opposing, second edge of the translucent object. A presence and/or a condition of the translucent object can then be determined based on the detected intensity of the light that passes through the object. The translucent object can be implemented as a multi-lens array, and a laser light is directed through optic surfaces of the multi-lens array with a laser. The presence and the condition of the multi-lens array can be continuously determined as a safety compliance of the laser light being directed through the multi-lens array.

In implementations, the detected intensity of the light that passes through the translucent object is relative, and can indicate the presence of the object based on a higher intensity of the light, or the object is not present based on a lower intensity of the light. Additionally, the detected intensity of the light that passes through the translucent object can indicate a damaged condition of the object, such as when the detected intensity of the light is approximately that of the lower intensity of the light. An object detection application can be implemented as part of a system that includes a light emitter, the translucent object, and a light detector. The object detection application can receive a voltage signal from the light detector, where the voltage signal is variable and corresponds to the detected intensity of the light that passes through the translucent object. The object detection application can then determine the presence and/or the condition of the translucent object based on the received voltage signal. The voltage signal may be one of above or below a voltage comparison threshold, or can be comparable to a light emission signature of the translucent object.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of object presence and condition detection are described with reference to the following Figures. The same numbers may be used throughout to reference like features and components that are shown in the Figures:

FIG. **1** illustrates an example system in which embodiments of object presence and condition detection can be implemented.

FIG. **2** illustrates example method(s) of object presence and condition detection in accordance with one or more embodiments.

FIG. **3** illustrates an implementation of the example system in which embodiments of object presence and condition detection can be implemented.

FIG. **4** illustrates an implementation of the example system in which embodiments of object presence and condition detection can be implemented.

FIG. **5** illustrates an example system in which embodiments of object presence and condition detection can be implemented.

FIG. **6** illustrates example method(s) of object presence and condition detection in accordance with one or more embodiments.

FIG. **7** illustrates an implementation of the example system in which embodiments of object presence and condition detection can be implemented.

FIG. **8** illustrates an implementation of the example system in which embodiments of object presence and condition detection can be implemented.

FIG. **9** illustrates an example system with an example device that can implement embodiments of object presence and condition detection.

DETAILED DESCRIPTION

Embodiments of object presence and condition detection are described and can be implemented to continuously and in real-time detect the presence and/or condition of a translucent object, such as a lens. In implementations, a light emitter directs a light at an edge of a translucent object to pass through the object. An intensity of the light is detected by a light detector at an opposing edge of the translucent object, and the presence and/or condition of the object can then be determined based on the detected intensity of the light that passes through the translucent object.

In a system, the translucent object can be implemented as a multi-lens array, and a laser light is directed through optic surfaces of the multi-lens array with a laser. The light emitter directs the emitted light through the multi-lens array from one edge to another in a direction perpendicular to an axis of the optic surfaces of the multi-lens array. The emitted light is non-intrusive to the function of the multi-lens array and does not interfere with the projection of the laser light. The presence and the condition of the multi-lens array can be continuously determined as a safety compliance feature when using the laser light that is directed through the optic surfaces of the multi-lens array.

While features and concepts of object presence and condition detection can be implemented in any number of different devices, systems, networks, environments, and/or configurations, embodiments of object presence and condition detection are described in the context of the following example devices, systems, and methods.

FIG. **1** illustrates an example system **100** in which embodiments of object presence and condition detection can be implemented. The system **100** includes a light emitter **102**, a light detector **104**, and a translucent object **106**. The light emitter **102** can be implemented as any type of light source, such as a light emitting diode (LED), that emits a light **108**, which is directed at a first edge **110** of the translucent object. The light emitter **102** can be implemented as one or more LEDs or other types of lights in the visible light spectrum, or in the infra-red (IR) light spectrum. The emitted light **108** is directed to pass through the translucent object **106** and the light detector **104** detects an intensity of the light proximate an opposing, second edge **112** of the translucent object. A presence and/or a condition of the translucent object **106** can then be determined based on the detected intensity of the light that passes through the object. The intensity of the light after traveling through the translucent object **106**, as measured by the light detector **104**, will be different depending on the presence and condition of the object, and a variable detector output can provide the presence and condition information in continuous real-time.

The light detector **104** can be implemented as a photo transistor, optical detector, or any type of transducer that has sensitivity to the wavelengths generated by the light emitter and that converts the light intensity to another signal form, such as to generate a voltage signal **114** corresponding to the detected intensity of the light **108** that passes through the translucent object. The presence and/or the condition of the translucent object **106** can be based on the voltage signal, which may be determined as being above or below a voltage comparison threshold, or can be comparable to a light emission signature of the translucent object.

Generally, the translucent object **106** can be any type of object that is transparent or semi-transparent allowing light to pass through, much like a waveguide, and may be implemented as any type of optic lens, lens system, or other object having any shape, color, and/or configuration. The translucent object **106** acts as a waveguide and concentrates the light emitter's divergent light beams, which can produce a higher intensity light at the light detector **104** than would otherwise occur if the translucent object was not present in the system. Any damage to the translucent object, such as a hole, a crack, or other type of damage, will reduce the passage of light through the object and thus reduce the intensity of light that the light detector receives. Therefore, to detect a high-enough intensity of the light at the light detector **104** to signal an acceptable condition, the translucent object **106** must be present (e.g., for the light **108** to pass through), and not damaged, which reduces the intensity of the light that can be detected. In alternate implementations, a light emitter **102** that emits a directed light can be utilized and the light is detected at a higher intensity by the light detector **104** if the translucent object **106** is not present. The intensity of the detected light may then be lower when the translucent object **106** is present due to dissipation of the light as it passes through the object.

In various implementations, the translucent object **106** may be implemented as a multi-lens array as described with reference to FIG. **3**. The translucent object **106** may also be implemented as an optic lens as described with reference to FIG. **4**. The translucent object **106** may also be implemented as a combination of objects as described with reference to FIGS. **7** and **8**. In the lens implementations, the light emitter **102** and the light detector **104** are aligned with the width (e.g., the thickness) of a lens, as opposed to the functional direction of a lens. For example, the light emitter **102** directs the emitted light **108** through a lens from one edge to another in a direction perpendicular to an axis of the optic surfaces of the lens, and the emitted light is non-intrusive to the function of a lens. In other implementations, techniques of the example system **100** may be implemented for any number of scenarios, such as in a tamper proof device to check that some component has not been removed, in a camera system to check that a lens has not been removed or has been installed, or in any type of system or device replacing a mechanical switch or for other fail-safe component checks.

Example methods **200** and **600** are described with reference to respective FIGS. **2** and **6** in accordance with one or more embodiments of object presence and condition detection. Generally, any of the components, modules, methods, and operations described herein can be implemented using software, firmware, hardware (e.g., fixed logic circuitry), manual processing, or any combination thereof. Some operations of the example methods may be described in the general context of executable instructions stored on computer-readable storage memory that is local and/or remote to a computer processing system, and implementations can include software applications, programs, functions, and the like.

FIG. **2** illustrates example method(s) **200** of object presence and condition detection, and is generally described with reference to the example system **100** shown in FIG. **1**. The order in which the method is described is not intended to be construed as a limitation, and any number or combination of the method operations can be performed in any order to implement a method, or an alternate method.

At **202**, light is emitted and directed to pass through a translucent object, and the light is directed at a first edge of the translucent object. For example, the light emitter **102** emits the light **108** that is directed at the first edge **110** of the translucent object **106** to pass through the object. At **204**, an intensity of the light is detected proximate an opposing, second edge of the translucent object. For example, the light detector **104** detects an intensity of the light proximate the opposing, second edge **112** of the translucent object **106**.

At **206**, a presence of the translucent object is determined based on the detected intensity of the light that passes through the translucent object. For example, the light detector **104** converts the detected intensity of the light **108** into the voltage signal **114** from which the presence of the translucent object **106** can be determined. In implementations, the detected intensity of the light is relative and indicates the presence of the translucent object based on a higher intensity of the light, or the translucent object is not present based on a lower intensity of the light. For example, the translucent object **106** acts as a waveguide and concentrates the light, which is detected as a higher intensity of the light at the light detector **104**, resulting in a lower voltage signal. If the translucent object **106** is not present in the system, then the light can be detected at a lower intensity of the light at the light detector **104**, resulting in a higher voltage signal. Alternatively, the system may be implemented so that the detected intensity of the light indicates the presence of the translucent object based on a lower intensity of the light (e.g., and/or a lower voltage signal), or the translucent object is not present based on a higher intensity of the light (e.g., and/or a higher voltage signal).

At **208**, a condition of the translucent object is determined based on the detected intensity of the light that passes through the translucent object. For example, the light detector **104** converts the detected intensity of the light **108** into the voltage signal **114** from which the condition of the translucent object **106** is determined. Any damage to the translucent object, such as a hole, a crack, or other type of damage, will reduce the passage of light through the object and thus reduce the inten-

sity of light that the light detector **104** receives. If the translucent object is damaged, or otherwise not in an operable condition, then the light will be detected at a lower intensity at the light detector **104**, resulting in a higher voltage signal, similar to when the translucent object is not present in the system.

FIG. **3** illustrates an example system **300** in which embodiments of object presence and condition detection can be implemented. The system **300** includes the light emitter **102** and the light detector **104** as described with reference to FIG. **1**. The system **300** also includes a multi-lens array **302**, which is an example of a translucent object, through which the light emitter **102** emits the light **108**, which is directed at a first edge **304** of the multi-lens array. The emitted light **108** is directed to pass through the multi-lens array **302** and the light detector **104** detects an intensity of the light proximate an opposing, second edge **306** of the multi-lens array. The light emitter **102** and the light detector **104** are aligned with the width (e.g., the thickness) of the multi-lens array **302**, as opposed to the functional direction of the multi-lens array.

The example system **300** also includes a laser **308** that directs a laser light **310** through optic surfaces **312** of the multi-lens array **302**. The light emitter **102** directs the light **108** through the multi-lens array from the first edge **304** to the second edge **306** in a direction perpendicular to an axis **314** of the optic surfaces **312** of the multi-lens array. The emitted light **108** is non-intrusive to the function of the multi-lens array **302** and does not interfere with the projection of the laser light. The presence and the condition of the multi-lens array can be continuously determined based on the detected intensity of the light that passes through the multi-lens array, and as a safety compliance feature when using the laser light that is directed through the optic surfaces of the multi-lens array.

The light detector **104** converts the detected light intensity to another signal form (e.g., the voltage signal **114**) that corresponds to the detected intensity of the light **108** that passes through the multi-lens array. The voltage signal **114** that indicates the presence and/or the condition of the multi-lens array **302** can be input to an emergency shut-off switch **316** that turns off the laser **308** if the multi-lens array is determined not to be present in the system, is damaged, or is in some other inoperable condition. The example system **300** has a fast response time (e.g., on the order of microseconds) to detect and signal the emergency shut-off switch **316**, and prevent potential injury that may be caused by the laser light. The system is applicable and can be implemented for any consumer device that may require a similar safety compliance feature.

FIG. **4** illustrates an example system **400** in which embodiments of object presence and condition detection can be implemented. The system **400** includes the light emitter **102** and the light detector **104** as described with reference to FIG. **1**. The system **400** also includes an optic lens **402**, which is an example of a translucent object, through which the light emitter **102** emits the light **108**, which is directed at a first edge **404** of the lens. The emitted light **108** is directed to pass through the lens **402** and the light detector **104** detects an intensity of the light proximate an opposing, second edge **406** of the lens. The light emitter **102** and the light detector **104** are aligned with the width (e.g., the thickness) of the lens **402**, as opposed to the functional direction of the lens. The light emitter **102** directs the light **108** through the lens from the first edge **404** to the second edge **406** along a diameter **408** of the lens and in a direction perpendicular to an axis **410** of the optic surfaces of the lens.

The example system **400** can also include any type of imaging and/or illumination component **412** that directs light **414** through the lens, or receives the light **414** through the lens. The emitted light **108** is non-intrusive to the function of the optic lens **402** and does not interfere with the light **414** that is directed and/or received through the optic surfaces of the lens. The presence and the condition of the lens **402** can be continuously determined based on the detected intensity of the light that passes through the lens. The light detector **104** converts the detected light intensity to another signal form (e.g., the voltage signal **114**) that corresponds to the detected intensity of the light **108** that passes through the lens. The voltage signal **114** that indicates the presence and/or the condition of the lens **402** can then be input to a signal comparator **416** that controls the imaging and/or illumination component **412** based on whether the lens is determined to be present or not in the system, is damaged, or is in some other inoperable condition. The example system **400** is applicable and can be implemented for any consumer device, such as to detect the presence of a lens in an interchangeable lens system, to detect not only that a translucent object has been installed, but that the object has been installed correctly, and/or for any other user operability verification and/or safety check.

FIG. **5** illustrates an example system **500** in which embodiments of object presence and condition detection can be implemented. The system **500** includes an example computing device **502** that may be any one or combination of a wired or wireless device, such as a mobile phone, tablet, computing, communication, entertainment, gaming, media playback, desktop computer, and/or other type of device implemented as a computing device. For example, the computing device **502** may be a gaming device, or a component of a gaming system, and include the example system **300** as shown and described with reference to FIG. **3**. The computing device **502** can include a wired and/or battery power source **504** to power the components, such as the light emitter **102**, the light detector **104**, the multi-lens array **302**, and the laser **308** that generates the laser light **310**. Any of the devices described herein, such as the computing device **502**, can be implemented with various components, such as a processing system and memory, as well as any number and combination of differing components as further described with reference to the example device shown in FIG. **9**.

The computing device **502** includes an object detection application **506** that can be implemented as a software application (e.g., executable instructions) stored on a computer-readable storage memory, such as any suitable memory device or electronic data storage. The computing device **502** can be implemented with a computer-readable storage memory as described with reference to the example device shown in FIG. **9**. Additionally, the computing device can be executed with a processing system to implement embodiments of object presence and condition detection, as described herein.

In embodiments, the object detection application **506** is implemented to receive the voltage signal **114** from the light detector **104**, from which the object detection application can determine lens presence **508** and/or a lens condition **510** (e.g., of the multi-lens array **302**). The light detector **104** converts the detected light intensity into the voltage signal **114** that corresponds to the detected intensity of the light **108** that passes through the multi-lens array **302**. The presence **508** and/or the condition **510** of the multi-lens array can be continuously determined by the object detection application **506** as a safety compliance feature when using the laser light that is directed through the optic surfaces of the multi-lens array.

In an embodiment, the object detection application **506** is implemented to compare the variable voltage signal **114** to a voltage comparison threshold **512** to determine the lens presence **508** and/or the lens condition **510** of the multi-lens array **302**. An example **514** illustrates the voltage comparison threshold **512** based on a voltage output **516** (e.g., the voltage signal) from the light detector **104**. In this example, an undamaged lens (e.g., the multi-lens array **302**) that is present in the system at **518** results in a lower voltage output that is below the voltage comparison threshold **512**, which indicates an operating condition of the lens is acceptable at **520**. As described earlier with reference to the example systems, the multi-lens array **302** can act as a waveguide and concentrate the emitted light **108**, which is detected as a higher intensity of the light at the light detector **104**, resulting in the lower voltage output that indicates an operating condition of the multi-lens array is acceptable.

The example **514** further illustrates that a lens missing from the system at **522** (e.g., no lens) results in a higher voltage output that is above the voltage comparison threshold **512**, which indicates an operating condition of the lens that is unacceptable at **524**. As described earlier, if the multi-lens array **302** is not present in the system, then the emitted light **108** is detected at a lower intensity of the light at the light detector **104**, resulting in the higher voltage output that indicates the operating condition of the multi-lens array is unacceptable. Based on a determination of the unacceptable operating condition, the object detection application **506** can initiate turning off the laser **308**, such as by signaling the shut-off switch **316**.

Similarly, the example **514** illustrates that damage to the multi-lens array **302** results in a higher voltage output that is above the voltage comparison threshold **512**, such as if the multi-lens array has a hole in it at **526** or is otherwise damaged at **528** (e.g., has been cracked or grooved). The higher voltage outputs that are above the voltage comparison threshold **512** indicate that the operating condition of the multi-lens array is unacceptable. In this implementation, any of the unacceptable operating conditions drive the voltage output **516** in the same direction, as voltage outputs that are higher than the voltage comparison threshold **512**, thus making it simple for the object detection application **506** to compare the voltage signal **114** against the comparison threshold **512** and distinguish the unacceptable operating conditions from an acceptable operating condition.

Although the voltage comparison threshold **512** is shown and described as a single voltage output level, the voltage comparison threshold **512** may also be implemented as a voltage comparison range **530**, such as shown in the example **514**. The voltage comparison threshold **512** and/or the voltage comparison range **530** can be established based on characterizing hundreds of similar lenses or translucent objects, and determining a typical voltage range of the voltage signal **114** that is output from the light detector **104**. In similar implementations, the object detection application **506** can detect the condition in which the multi-lens array **302** is present and undamaged in the system, yet has been installed upside-down, based on a voltage signal that is similar to when the multi-lens array is missing from the system.

In other systems and implementations, the presence and/or the condition of the multi-lens array **302** can be based on a comparison of the voltage signal **114** to a light emission signature **532** of the multi-lens array. For example, the emitted light **108** that passes through a translucent object may be detected based on a unique geometry and/or configuration of the object, and the light that is detected by the light detector **104** is a unique light emission signature **532** of the particular object. In the computing device **502**, the multi-lens array **302** of the example system **300** can be initially calibrated to determine its light emission signature **532**. The object detection application **506** can then continuously and in real-time determine the presence and/or the condition of the multi-lens array **302** based a comparison of the light emission signature **532** to the voltage signal **114** that is received from light detector **104**.

FIG. **6** illustrates example method(s) **600** of object presence and condition detection, and is generally described with reference to the example system **500** shown in FIG. **5**. The order in which the method is described is not intended to be construed as a limitation, and any number or combination of the method operations can be performed in any order to implement a method, or an alternate method.

At **602**, a laser light is directed through optic surfaces of a lens with a laser. For example, the laser **308** that is implemented in the computing device **502** (FIG. **5**) generates the laser light **310** that is directed through the optic surfaces **312** (FIG. **3**) of the multi-lens array **302**. At **604**, light is emitted and directed to pass through the lens, and the light is directed at a first edge of the lens. For example, the light emitter **102** emits the light **108** that is directed at the first edge **304** of the multi-lens array **302** to pass through the multi-lens array.

At **606**, an intensity of the light is detected proximate an opposing, second edge of the lens. For example, the light detector **104** detects an intensity of the light **108** proximate the opposing, second edge **306** of the multi-lens array **302**. In the example systems, a lens can be implemented as the multi-lens array **302** as shown in FIGS. **3** and **5**, or as the optic lens **402** shown in FIG. **4**, and the light **108** is emitted and directed to pass through along the diameter **408** of the optic lens and perpendicular to the axis **410** of the lens. The detected intensity of the light that passes through any of the translucent objects is relative and can indicate the presence of an object based on a higher intensity of the light, or that the object is not present based on a lower intensity of the light. Alternatively, systems may be implemented to determine the presence of a translucent object based on a lower intensity of the light, or that the object is not present based on a higher intensity of the light.

At **608**, a voltage signal is received that corresponds to the detected intensity of the light that passes through the lens. For example, the object detection application **506** that is implemented by the computing device **502** receives the voltage signal **114**, and the object detection application can determine the presence and/or the condition of the multi-lens array **302** based on the voltage signal that corresponds to the detected intensity of the light.

At **610**, a determination is made as to whether the lens is present based on the detected intensity of the light that passes through the lens. For example, the object detection application **506** determines the presence of the multi-lens array **302** in the system based on the voltage signal **114** being one of above or below the voltage comparison threshold **512**, or the object detection application **506** compares the voltage signal **114** to the light emission signature **532** of the multi-lens array.

If the lens is not present, such as having been removed or is broken out (i.e., "no" from **610**), then at **612**, the laser is turned off. For example, the object detection application **506** initiates turning off the laser **308**, such as by signaling the shut-off switch **316**. If the lens is present (i.e., "yes" from **610**), then at **614**, a determination is made as to whether the lens is in an operable condition based on the detected intensity of the light that passes through the lens. For example, the object detection application **506** determines whether the multi-lens array **302** is in an operable condition based on the voltage signal **114** that corresponds to the detected intensity

of the light, which indicates a damaged condition of the multi-lens array if the detected intensity is approximately that of the lower intensity of the light.

If the lens is not in an operable condition, such as having been cracked or otherwise damaged (i.e., "no" from **614**), then at **612**, the laser is turned off. For example, the object detection application **506** initiates turning off the laser **308**, such as by signaling the shut-off switch **316**. If the lens is in an operable condition (i.e., "yes" from **614**), then at **616**, the presence and the condition of the lens is continuously determined in real-time as a safety compliance when the laser light is directed through the lens. Accordingly, the method continues at **610** to determine whether the lens (e.g., the multi-lens array **302**) is present and at **614** to determine whether the lens is in an operable condition based on the detected intensity of the light that passes through the lens.

FIG. **7** illustrates an example system **700** in which embodiments of object presence and condition detection can be implemented. The system **700** includes the light emitter **102** and the light detector **104** as described with reference to FIG. **1**. The system **700** also includes multiple translucent objects **106** in a stacked configuration **702** through which the light emitter **102** emits the light **108**. The emitted light **108** is directed to pass through the translucent objects **106** and the light detector **104** detects an overall intensity of the light that passes through the stacked configuration **702** of the translucent objects. The example system **700** illustrates that one set of the light emitter **102** and light detector **104** components can be implemented for multiple translucent objects.

FIG. **8** illustrates an example system **800** in which embodiments of object presence and condition detection can be implemented. The system **800** includes a similar stack configuration **802** of the translucent objects **106** as described with reference to FIG. **1**. The example system **800** illustrates that, for multiple translucent objects, each translucent object is implemented with an associated set of the light emitter **102** and light detector **104** components. Each light emitter **102** emits the light **108** that is directed to a particular one of the translucent objects **106**, and a corresponding light detector **104** detects the intensity of the light that passes through the particular, associated translucent object.

FIG. **9** illustrates an example system **900** that includes an example device **902**, which can implement embodiments of object presence and condition detection. The example device **902** can be implemented as any of the computing devices described with reference to the previous FIGS. **1-8**, such as any type of client device, mobile phone, tablet, computing, communication, entertainment, gaming, media playback, and/or other type of device. For example, the computing device **502** shown in FIG. **5** may be implemented as the example device **902**.

The device **902** includes communication devices **904** that enable wired and/or wireless communication of device data **906**, such as object presence and condition determination information, voltage comparison threshold values, and light emission signatures of the various translucent objects, lenses, and multi-lens arrays. Additionally, the device data can include any type of audio, video, and/or image data. The communication devices **904** can also include transceivers for cellular phone communication and for network data communication.

The device **902** also includes input/output (I/O) interfaces **908**, such as data network interfaces that provide connection and/or communication links between the device, data networks, and other devices. The I/O interfaces can be used to couple the device to any type of components, peripherals, and/or accessory devices. The I/O interfaces also include data input ports via which any type of data, media content, and/or inputs can be received, such as user inputs to the device, as well as any type of audio, video, and/or image data received from any content and/or data source.

The device **902** includes a processing system **910** that may be implemented at least partially in hardware, such as with any type of microprocessors, controllers, and the like that process executable instructions. The processing system can include components of an integrated circuit, programmable logic device, a logic device formed using one or more semiconductors, and other implementations in silicon and/or hardware, such as a processor and memory system implemented as a system-on-chip (SoC). Alternatively or in addition, the device can be implemented with any one or combination of software, hardware, firmware, or fixed logic circuitry that may be implemented with processing and control circuits. The device **902** may further include any type of a system bus or other data and command transfer system that couples the various components within the device. A system bus can include any one or combination of different bus structures and architectures, as well as control and data lines.

The device **902** also includes a computer-readable storage memory **912**, such as data storage devices that can be accessed by a computing device, and that provide persistent storage of data and executable instructions (e.g., software applications, programs, functions, and the like). Examples of the computer-readable storage memory **912** include volatile memory and non-volatile memory, fixed and removable media devices, and any suitable memory device or electronic data storage that maintains data for computing device access. The computer-readable storage memory can include various implementations of random access memory (RAM), read-only memory (ROM), flash memory, and other types of storage media in various memory device configurations.

The computer-readable storage memory **912** provides storage of the device data **906** and various device applications **914**, such as an operating system that is maintained as a software application with the computer-readable storage memory and executed by the processing system **910**. In this example, the device applications include an object detection application **916** that implements embodiments of object presence and condition detection, such as when the example device **902** is implemented as the computing device **502** shown in FIG. **5**. An example of the object detection application **916** is the object detection application **506** that is implemented by the computing device **502**, as described with reference to FIGS. **5** and **6**.

The device **902** also includes an audio and/or video system **918** that generates audio data for an audio device **920** and/or generates display data for a display device **922**. The audio device and/or the display device include any devices that process, display, and/or otherwise render audio, video, display, and/or image data. In implementations, the audio device and/or the display device are integrated components of the example device **902**. Alternatively, the audio device and/or the display device are external, peripheral components to the example device.

In embodiments, at least part of the techniques described for object presence and condition detection may be implemented in a distributed system, such as over a "cloud" **924** in a platform **926**. The cloud **924** includes and/or is representative of the platform **926** for services **928** and/or resources **930**. For example, the services **928** and/or the resources **930** may include the object detection application, as well as the various object presences and detection data.

The platform **926** abstracts underlying functionality of hardware, such as server devices (e.g., included in the ser-

vices **928**) and/or software resources (e.g., included as the resources **930**), and connects the example device **902** with other devices, servers, etc. The resources **930** may also include applications and/or data that can be utilized while computer processing is executed on servers that are remote from the example device **902**. Additionally, the services **928** and/or the resources **930** may facilitate subscriber network services, such as over the Internet, a cellular network, or Wi-Fi network. The platform **926** may also serve to abstract and scale resources to service a demand for the resources **930** that are implemented via the platform, such as in an interconnected device embodiment with functionality distributed throughout the system **900**. For example, the functionality may be implemented in part at the example device **902** as well as via the platform **926** that abstracts the functionality of the cloud **924**.

Although embodiments of object presence and condition detection have been described in language specific to features and/or methods, the appended claims are not necessarily limited to the specific features or methods described. Rather, the specific features and methods are disclosed as example implementations of object presence and condition detection.

The invention claimed is:

1. A method, comprising:
emitting light that is directed to pass through a lens, the light directed at a first edge of the lens;
detecting an intensity of the light proximate an opposing, second edge of the lens; and
determining a presence of the lens based on the detected intensity of the light that passes through the lens, the detected intensity of the light that passes through the lens is relative and indicates one of:
the presence of the lens based on a higher intensity of the light; or
the lens is not present based on a lower intensity of the light.

2. The method as recited in claim **1**, further comprising:
determining a condition of the lens based on the detected intensity of the light that passes through the lens.

3. The method as recited in claim **2**, further comprising:
directing a laser light through optic surfaces of the lens with a laser;
continuously said determining the presence and the condition of the lens to prevent shut-off of said directing the laser light through the lens.

4. The method as recited in claim **1**, wherein the lens is a multi-lens array, and said emitting the light that is directed at the first edge of the of the multi-lens array to pass through to the opposing, second edge of multi-lens array.

5. The method as recited in claim **1**, wherein the lens is an optic lens, and said emitting the light that is directed to pass through along a diameter of the optic lens and perpendicular to an axis of the optic lens.

6. The method as recited in claim **1**, wherein the detected intensity of the light indicates a damaged condition of the lens, the detected intensity approximately that of the lower intensity of the light.

7. The method as recited in claim **1**, further comprising:
receiving a voltage signal from a light detector that detects the intensity of the light that passes through the lens, and said determining the presence of the lens based on the voltage signal that corresponds to the detected intensity of the light.

8. The method as recited in claim **7**, wherein the presence of the lens is determined based on the voltage signal being:
one of above or below a voltage comparison threshold; or
comparable to a light emission signature of the lens, the light emission signature of the lens calibrated with the light detector when the lens is in an operable condition.

9. A method, comprising:
emitting light that is directed to pass through a translucent object, the light directed at a first edge of the translucent object;
detecting an intensity of the light proximate an opposing, second edge of the translucent object; and
determining a presence of the translucent object based on the detected intensity of the light that passes through the translucent object, the detected intensity of the light that passes through the translucent object is relative and indicates one of:
the presence of the translucent object based on a higher intensity of the light; or
the translucent object is not present based on a lower intensity of the light.

10. The method as recited in claim **9**, further comprising:
determining a condition of the translucent object based on the detected intensity of the light that passes through the translucent object.

11. A system, comprising:
a light emitter configured to emit light that is directed to pass through a translucent object, the light directed at a first edge of the translucent object; and
a light detector configured to detect an intensity of the light proximate an opposing, second edge of the translucent object, a presence of the translucent object determinable based on the detected intensity of the light that passes through the translucent object, the detected intensity of the light that passes through the translucent object is relative and indicates one of:
the presence of the translucent object based on a higher intensity of the light; or
the translucent object is not present based on a lower intensity of the light.

12. The system as recited in claim **11**, further comprising:
a memory and processing system to implement an object detection application that is configured to:
receive a voltage signal from the light detector, the voltage signal corresponding to the detected intensity of the light that passes through the translucent object; and at least one of:
determine the presence of the translucent object based on the received voltage signal; and
determine a condition of the translucent object based on the received voltage signal.

13. The system as recited in claim **12**, wherein the object detection application is configured to determine the presence of the translucent object based on the voltage signal being:
one of above or below a voltage comparison threshold; or
comparable to a light emission signature of the translucent object, the light emission signature of the translucent object calibrated with the light detector.

14. The system as recited in claim **12**, further comprising:
a laser configured to direct a laser light through optic surfaces of the translucent object that is implemented as a lens; and wherein:
the object detection application is configured to continuously determine the presence and the condition of the lens to prevent shut-off of the laser light being directed through the lens.

15. The system as recited in claim **11**, wherein the translucent object is a multi-lens array and the light is directed at the first edge of the multi-lens array to pass through to the opposing, second edge of multi-lens array.

16. The system as recited in claim 11, wherein the detected intensity of the light that passes through the translucent object indicates a damaged condition of the translucent object, the detected intensity approximately that of the lower intensity of the light.

17. The method as recited in claim 3, further comprising:

responsive to determining a damaged condition of the lens, shutting-off the laser.

18. The method as recited in claim 9, further comprising:

directing a laser light through optic surfaces of the translucent object with a laser.

19. The method as recited in claim 18, further comprising:

responsive to determining a damaged condition of the translucent object, shutting-off the laser.

20. The system as recited in claim 16, further comprising:

a shut-off switch configured to shut-off the laser responsive to receiving an indication of the damaged condition of the translucent object from the object detection application.

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